MUNICIPAL DEPARTMENT

THE SEWERAGE OF VICTORIA, B.C.*

The construction of a sewer system for Victoria was decided upon in 1890. As the site of the city was nearly surrounded by salt water, toward which the slopes are such as to easily carry off surface water, and as the rainfall of the summer months is so light that large sewers would not be self-cleansing, it was determined to adopt the separate system. This determination was further influenced by the great expense to be incurred in constructing a combined system where good brick were scarce and rock excavation unavoidable. The corporation having called for competitive plans, nine sets were presented. These were submitted to Mr. Rudolph Hering, M. Am. Soc. C. E., of New York City, who reported in favor of Mr. Mohun's plans. Mr. Mohun was accordingly appointed Chief Engineer, and Mr. E. A. Wilmot, M. Can. Soc. C. E., resident engineer. The sewers range in size from 8 inch vitrified pipe to 34x51 inch egg-shaped concrete sewers. In designing them it was estimated that each 25 feet of frontage in the closely built area and each 60 feet of frontage in residential area represented a dwelling inhabitated by five persons, from each of whom five gallons of sewage an hour might be expected. The Doulton syphon type of automatic flush tank was used and Shone ejectors raise the sewage of several low-lying districts into the gravity outfall system. The 34x51 inch outfall sewer terminates in a concrete house, from which the sewage, after falling through a grating, is conveyed in a 22-inch steel pipe to a point below low water mark and 240 feet from shore. There is also a 16-inch steel overflow pipe 120 feet long. Both these pipes are laid in a trench through solid rock and imbedded in concrete. The concrete sewers were laid with a fall of 1 in 1,200. The concrete was made of 2½ parts shingle, 2½ parts sand, and 1 part best English Portland cement. The shingle and sand were both from the sea beach and were perfectly free from impurities. Very great care was exercised in mixing. On a roomy platform a rectangular frame, without top or bottom, was placed; in this was deposited 2½ barrels of shingle, which was spread to an even depth; on this 2½ barrels of sand were similarly spread, the two layers aggregating 6 inches in thickness; on top of the sand one barrel of cement was evenly spread and the frame removed; the whole was then turned over with shovels two or three times while dry till thoroughly mixed, after which the turning was continued, while water was gradually added through a rose nozzle until a sufficient consistency was attained, when it was immediately wheeled into place, deposited in thin layers, and immediately rammed. All surfaces unfinished at the close of the day were left rough and porous and well grouted on the resumption of the work.

During the construction of the concrete sewers malicious reports were constantly being circulated to the effect that the sewers were leaky, that the grades ran in the wrong directions, etc., yet upon the completion of the work, when men were sent through for the special purpose of detecting any flaws, it was found that the sewer from invert to springing line was a monolith 9,244 feet long without crack or flaw; at the junction with the arch a few small leaks were discovered which were easily stopped with a little cement. As the ground water was higher than the crown of the sewer, it is thought impossible that a leak in the invert or sides should have remained undiscovered.

The method adopted in building the concrete sewers was as follows:

In earth the trench was excavated 4 inches wider than the outer measurement of the sewer, and 9 inches below the level of the invert, and the sides planked with 2-inch lumber. In fine sand a plank bottom 9 inches below the invert was also placed. In rock or hardpan the planking was altogether omitted, and the concrete was in this instance to be not less than 6 inches thick.

In the bottom of the trench the concrete was well rammed to a sufficient height to allow the channel pipe to be laid with absolute accuracy both as to grade and alignment. Lightly resting on the channel pipe, and secured to the planking on each side, molds shaped to the lower section of the sewer were placed, and the concrete well rammed between them and the plank wall with a T-headed iron having a slightly curved handle. These molds were allowed to remain 36 hours; that is to say, the molds placed on Monday would be removed on Wednesday, another set being used for Tuesday's work. Upon the removal of the molds the surface was rendered perfectly smooth with 2 to 1 cement mortar, after which centers for the arch, resting on the channel pipe, were placed, and the top of the walls having been well grouted the work was carried on in a similar manner.

In order to give some employment to the Victoria brick yards it was originally proposed to build the arch of radial brick, but the difficulty of obtaining thoroughly good material caused this plan to be abandoned, after between 1,700 and 1,800 feet of brick arch had been built, and concrete was substituted. As the work proceeded, water was pumped into the sewer to prevent the concrete drying too rapidly. The concrete for the manholes was handled in a similar manner.

It may be stated that the manholes and flush tanks were made rectangular to save the heavy carpenter's bill which would have been incurred in making oval or circular molds, as many different ones would have been required, the manholes varying much in size and shape, particularly on the main sewers. By using the rectangular form the frames of rough plank could be set by common labor, and if not used again for the same purpose, could be utilized in timbering trenches, etc.

PIPE SEWERS.

In rock trenching the excavation was carried down 6 inches below the invert and the bed brought to its true grade with 14 to 1 concrete. When unsound ground was found in the bottom of a trench it was removed and replaced with 14 to 1 concrete, except when a plank flooring and piling were needed.

Pipe on being delivered at the corporation yard were inspected and tested, and the rejected pipe broken up or carted away. The good pipe were then provided with Stanford joints and delivered to the contractor's teams. Inspectors of pipe laying, of course, examined each pipe as laid. A few large and but slightly cracked pipe were surrounded by concrete and used, and other slightly imperfect pipe used as ventilators. The kettles for boiling the tar, to evaporate the ammonia, and for melting the "compo" for the Stanford pipe joints, were heated by gas at a cost of about 13½ cents each per day. The "compo" was made of crude rock sulphur, clean sharp sand (not sea) and coal tar. A greater proportion of sand was used for the larger sizes than for the smaller. An average mixture would probably be about 4 of sulphur, 6 of sand, and 1 of tar, by measure. The cost of making this joint was somewhat larger than was anticipated, but it cost less to lay than a cement joint. A defective pipe can be replaced, or a junction substituted for a straight, and an absolutely water-tight joint made under water with reasonable care. No separate account was kept of the time spent occupied in joining, receiving, testing, culling and delivering, but Mr. Mohun thinks that one-third of the cost may reasonably be deducted for the latter. Upon this basis the following would approximate the cost of jointing per lineal foot of pipe—viz: 8-inch, 6½ cents; 9-inch, 7½ cents; 10-inch, 8¼ cents; 12-inch, 10 cents; 15-inch, 12¼ cents; 18-inch, 15 cents; and 20-inch, 16½ cents. The contract price for laying was 10 cents per lineal foot for 18 and 20 inch pipe and six cents for the smaller sizes. This price included loading, hauling and unloading.

At manholes in leading the subsidiary into the larger stream the former follows a curve whose radius is five times the diameter of the sewer, and the tangents of which are the direction of the two sewers. The invert of the smaller sewer is in all cases raised above that of the larger, and the fall is slightly increased on the curve to compensate for friction. Manhole inlet have vulcanite flap valves, and the outlets have gate grooves to enable them to be used as flush tanks.

Ventilators which serve also as lamp-holes are spaced about 300 feet apart. They consist simply of a vertical pipe surrounded by 7 to 1 concrete, 3 feet square, the surface of which is 1 foot below the street level. On this stands a cast-iron curb with a perforated cover.

(To be Continued.)

*Abstract of a paper read by Mr. Edward Mohun before the Canadian Society of Civil Engineers.